



Case Report

Tyre-blast injuries

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ARTICLE INFO

Article history:

Received 19 February 2008

Received in revised form 8 December 2008

Accepted 9 December 2008

Available online 29 January 2009

Keywords:

Tyre-blast

Tyre-blast injuries

Air-pressure injuries

Tyre burst

Burst-tyre

ABSTRACT

A teenager college student was fatally injured by burst tyre air pressure while waiting on a public bus stand to catch a bus to reach her college at Kuala Lumpur. She accidentally came near the wheel while boarding when tube and tyre got burst. The air pressure had blown the girl in the air and she subsequently fell on a rough surface. The iron-locking rim of the wheel acted as a missile and hit the girl. She died on her way to the hospital. A medico-legal autopsy was performed which showed extensive injuries in the cranial and chest cavity. Head had large scalp laceration with diffuse separation and gaping from in the vault region; skull bones were fractured. Chest cavity had extensive rib fractures, lacerated lungs and haemo-thorax while externally there was no obvious injury. It requires intensive care management and screening of the victims. Tyre-blast injuries are not so common. This case exposes the hazard due to burst tyre.

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1. Introduction

Injuries caused by exploding tyres can be seen as direct injuries caused by metal rim fragments, and barotraumas as a result of high pressures. It causes displacement of the body surface. The acceleration of the body surface also generates an internal pressure wave. This causes pressure differential in different body tissues and viscera. Primary blast injury is well documented to affect the lungs, gut and ears. Secondary blast injuries refer to damage sustained when objects, accelerated by the initial detonation or subsequent overpressure loads, strike the body – these may be fragments of tyre and tube or parts present near the wheel. Tertiary blast injuries result from the displacement of the body (or parts of the body) by the blast wave and can lead to avulsion (impact with solid objects). A range of injuries caused by fragments of the rim have been documented in the literature including maxillofacial injuries, long bone fractures and catastrophic head injury. Barotraumas can cause tympanic perforation and eye injury, as well as the more severe documented injuries including oesophageal rupture and pneumomediastinum.^{1–4}

When a tyre is being run continuously under inflation, at some stage of its life, the excess flexing in the sidewall of the tyre leads to fatigue failure in its wall which may be indicated by crackling sounds or visible obvious tears in it. On many occasions tyre tough belt also get separated due to over inflated tube pressure. This can happen due to poor maintenance, punctures, incorrect repairs,

leaking valves, bent rim flanges. A “Zipper” failure in a bus/truck steel radial tyre is a condition where the tyre basically blows out with extreme force in the mid to upper sidewall area, exposing an even line of severed casing steel cords along a considerable length.² The rupture begins in one cord location, and then progress along the sidewall as one after other carcass cords are compressed and fail due to almost instantaneous transfer of forces. This gives the appearance of an open zipper, hence the use of the name to describe this sometimes-catastrophic event’.

2. Case summary

An 18-year-old female of stout build, was waiting on the bus stand to catch bus to her college in the early morning hours. The wheel of public transport bus burst and caused her death. A complete medico-legal autopsy was performed on her at PPUM hospital Kuala Lumpur. This fatality by burst tyre of a public transport is reported here in detail with injury photographs [1–7] and repositioned wheel is shown in Fig. 8.

On postmortem examination, body of young female, had rigor mortis present all over the body, postmortem lividity faintly present over the back and dependent parts of the body in supine position. The face and head were tied with white bandage (Fig. 1) bleeding from right ear, trouser clean. There was abraded contusion over the right side of face and oozing of blood from right ear (Fig. 2). There was confluent abraded bruise over left shoulder and upper back adjoining shoulder area (Fig. 3) and part of upper limb and an abraded area in the lower back of abdominal area. A lacerated wound of size 8 × 4 cm was present on the occipital region with diffuse sub scalp haematoma and a gaping fissure

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fracture running from occipital area to posterior clinoid process in the mid brain (Figs. 4 and 5). On internal examination diffuse subdural haematoma was present over entire brain surface and large subarachnoid haemorrhage was also present over both cerebral hemispheres and basal areas.

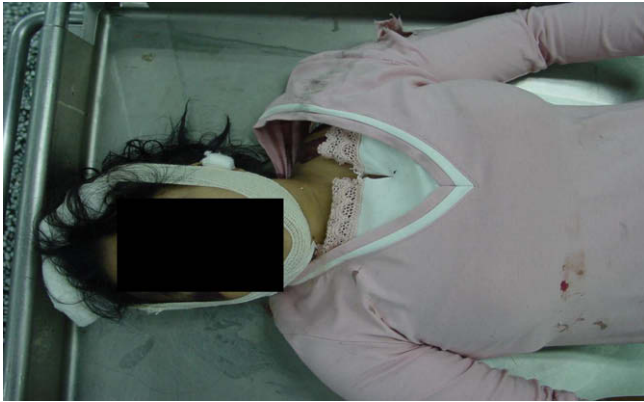


Fig. 1. Torn T-shirt due to air-blast impact, grease and dirt over left front area, rest clothing intact and clean.



Fig. 2. Abraded area over right-side face and forehead with bleeding from ear.



Fig. 3. Abraded area over left shoulder and upper arm.

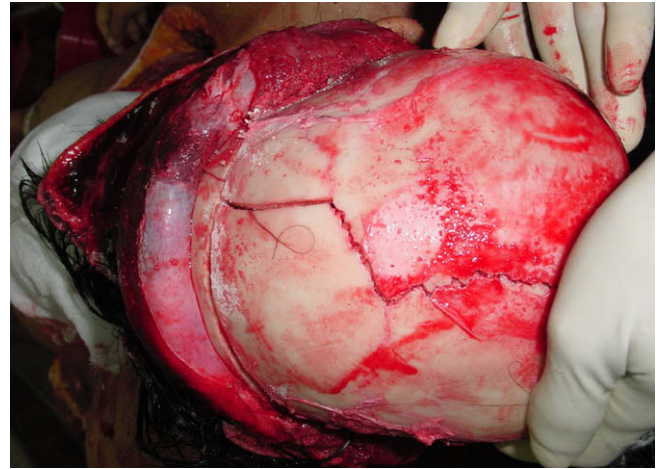


Fig. 4. Fractured skull over vertex and frontal area with visible contused scalp.

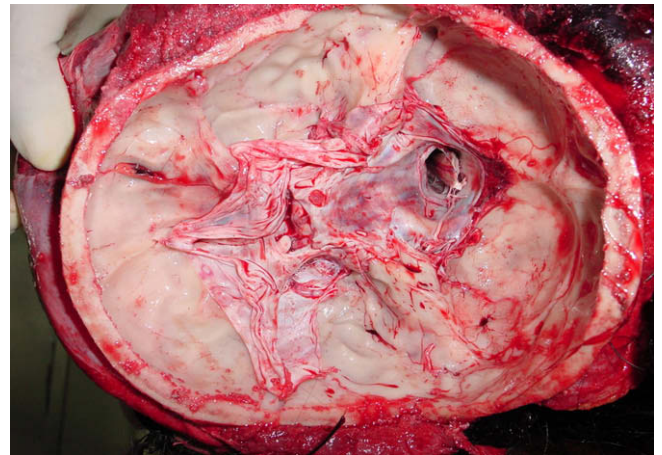


Fig. 5. Long skull fracture extending to posterior clinoid processes. Skull bones were very thick still impact was so severe that caused fissure fracture.



Fig. 6. Bilateral contusions with fractures of ribs (exposed by postmortem incisions).

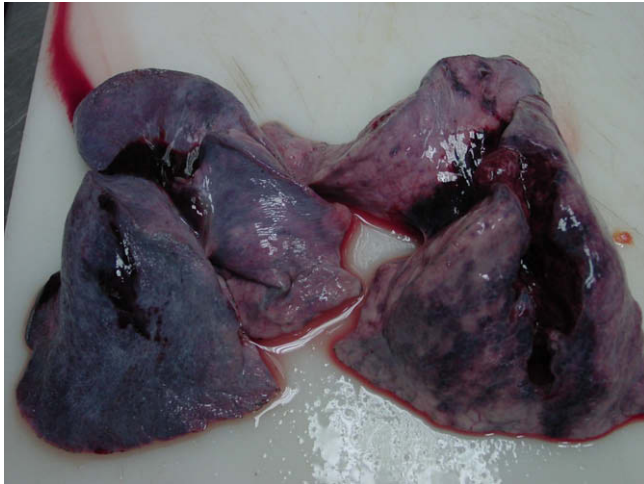


Fig. 7. Contused, punctured, lacerated and partly collapsed lungs.



Fig. 8. Repositioned tyre of the bus showing wheel and iron rim. In this case, when bus was seen the tyre was already repositioned in place of burst tyre. So exact nature of tears and rim damage could not be assessed.

The chest cavity was full of blood (about 1.5 l) on both sides. Both side chest walls showed diffuse contusion and rib fractures in mid-clavicular and para vertebral areas posteriorly (Fig. 6). Lungs were partly collapsed and showed contusion and laceration on posterior and sides of the lobes (Fig. 7). These were due to combined effect of high pressure and probably raised pavement side and rough road surface which contributed in the causation of injuries. The diffuse abraded areas on the shoulder and side of the face were caused by rough road surface. In this case, eye witnesses accounted flying of the girl about 2 ft and then falling on the road about 3 ft away from the blasted tyre.

The toxicological analysis did not detect any drug or alcohol. Death was due to shock as the result of multiple injuries [mainly head and chest injuries] due to blast effect of tyre burst. She died immediately due to profound shock.

3. Discussion

Pneumatically-induced injuries of the various nature due to tyre blast are quite rare and scantily described in the forensic literature. There have been instances of tyres burst in the past that did not result in the fatality. There is report of fatal incidents by Gilbert⁵ and Rautji et al.⁶ In one reported case, one mechanic sustained penetrating mandibular injury, associated with atlanto-occipital

dislocation, from the handle of a sledgehammer when the inner tube of a military truck burst during repositioning.⁵

In the case reported by Rautji et al.⁶, the deceased had been engaged in fitting the locking rim of a mounted crane tyre, when the fatal event occurred. As per the eyewitnesses, the deceased was repositioning the ill-fitted, iron-locking rim of fully inflated tyre mounted on the vehicle. He had been standing in front of the mounted tyre and was repositioning the locking rim with a small iron rod when inner tube of the tyre burst, the sudden increase of highly pressurized air hit the deceased with great force. He was thrown back against the stone wall striking his head, resulting fracture of skull bones and injury to brain. The injuries to face, right humerus shaft, urinary bladder, and pelvis had been caused by the flying iron-locking rim.⁶

In this case, victim had been blown off the ground and hit the road and iron part of the wheel area of the bus which resulted in scalp laceration and separation, and striking the blunt surface resulted in large fracture. The blown air had hit the back of her and resulted in the diffuse extravasations of the blood in posterior chest wall and fractures of the ribs. This blast effect also caused rupture of tympanic membrane leading to ear bleeding, and in the chest it caused contusion of both lungs resulting in haemo-pneumothorax. In the previously reported cases, only facial and head injuries were reported, while these cases had extensive blast injury effect in the ear and chest without any obvious external injury indicators. The tyre pressure of 300–400 kPa can have lethal impact like in this present case. This incident was witnessed by the bus passengers and other passengers standing on the bus stand away from the bus. Pneumatically-induced injuries of this nature due to tyre burst described here are rare.

This case did not have obvious external injuries. Majority of the injuries were internal and were totally disproportionate to external injuries. The pneumatic pressure in bus tyre usually remains in 300–400 Kpa, on an average 320–360 Kpa, which has produced severe trauma in this case. In literature, there are only few references available regarding tyre-blast injuries and its impact on human body. In this case, extent of external injuries, internal injuries and impact on the organs have been described in detail. Any such incident should not be taken lightly and surviving victims should be screened thoroughly as internal damage is beyond expectation especially when there are no visible signs externally. The death in this case was immediate as skull was fractured and there was gross haemorrhage in the brain. Three patients out of 2600 patients in our registry had tyre-blasts injuries during servicing (0.001%). The blasts occurred during inflation of big vehicle tyres. All injuries were severe and multiple. Two patients died after admission. Injury is caused by the pressure of the explosion or due to direct injury by the rim. The head and face are the most commonly affected body regions (48%) followed by the upper limbs (20%). About 25% of patients had multi-trauma. The overall mortality is high (20%) and is mainly caused by head injuries.⁷

A standard inflated tyre-tube explosion has sufficient force to lift a passenger vehicle three meters off the ground and result in the death of the person facing it. A tyre must be inspected for side-wall cracks, distortions, wrinkles, discoloration, repairs prior to any recent inflation. The eyes can be injured by high-velocity air and dust particles, oil and other debris. An exploding wheel is a high-speed projectile that can kill or maim anyone in its path. The air blast alone can cause injury and hearing loss. In such situations risks are from: compressed air, exploding or disintegration of wheels and tyres, and noise. This case has highlighted the seriousness of burst- tyre accident. This case also highlights the danger of pressurized tyres which are usually presumed as 'minor' explosion. It also emphasizes the need for thorough examination in the accident emergency department in such blast victims.

Although such a blast has limited air and blast capacity but this amount of air and missiles produced thereof can be fatal as in this case. Tyre-blast injuries during servicing or accidental burst have tremendous amount of injury and can be lethal.

Conflict of interest statement

Nothing declared.

Funding

No financial help was taken from any source.

Ethical

No ethical approval is needed.

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